Nano-size Dependence in the Adsorption by the SARS-CoV-2 Spike Protein Over Gold Colloid

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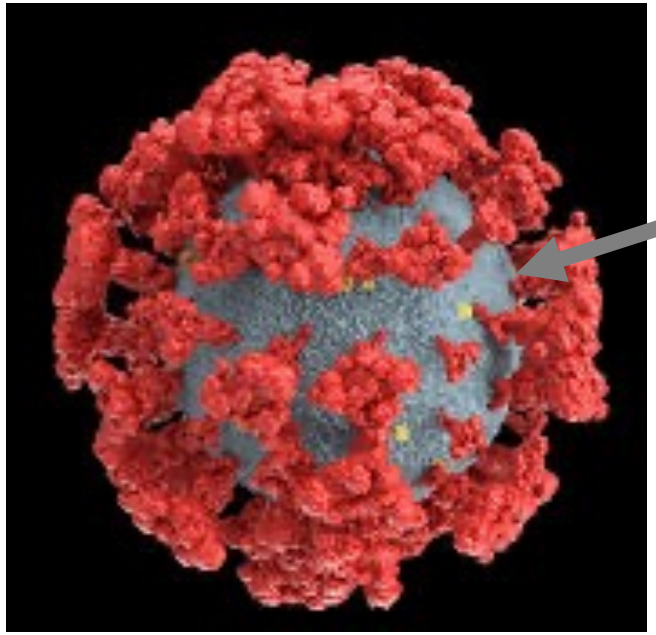
GENESEO

S protein plays a major role in infection

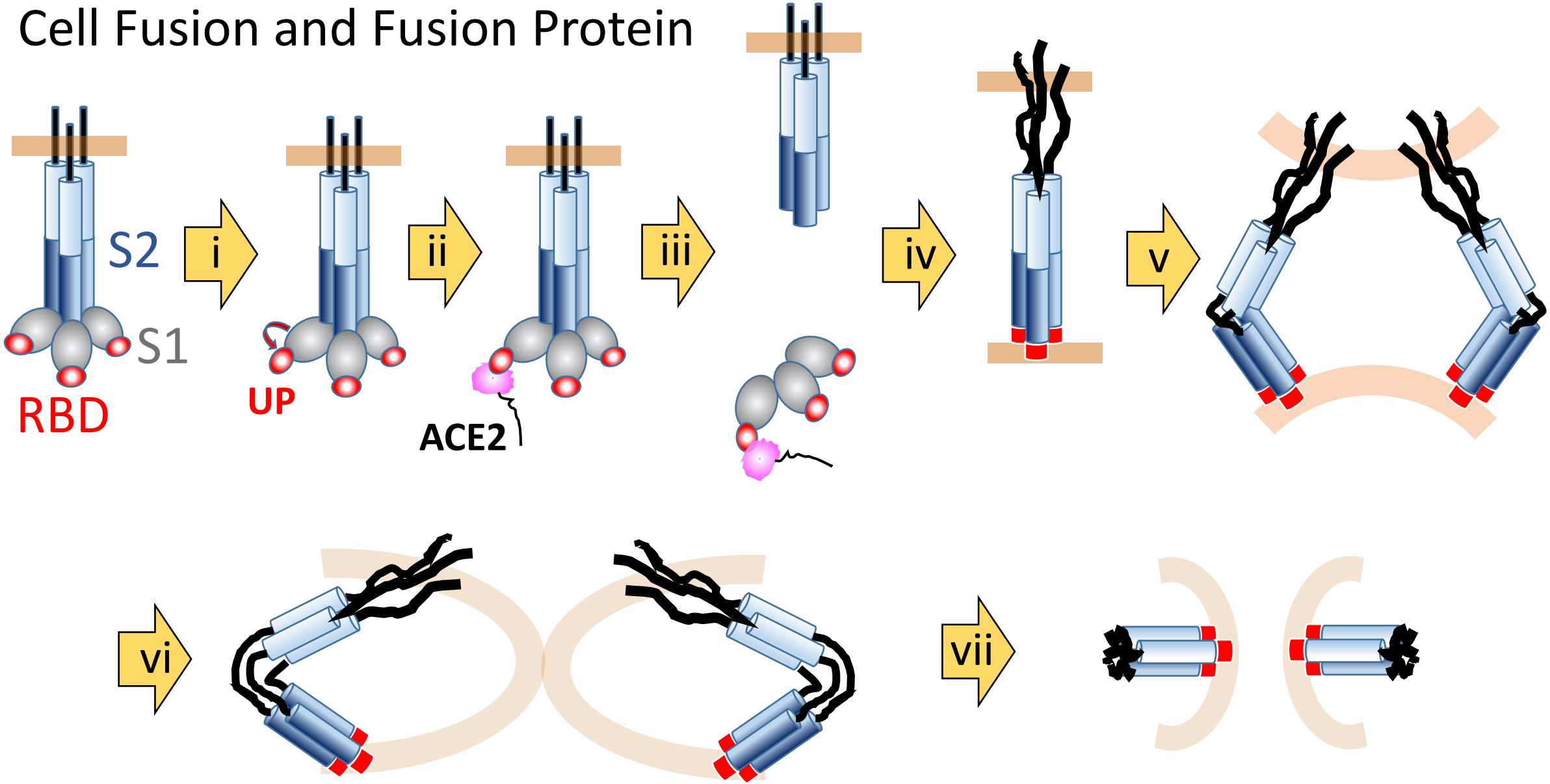
Interested in applying its
"***mechanical molecular motion***" in S protein



Our Aim

Replace the membrane and core part with gold nano particle and create a platform to understand more about S protein .

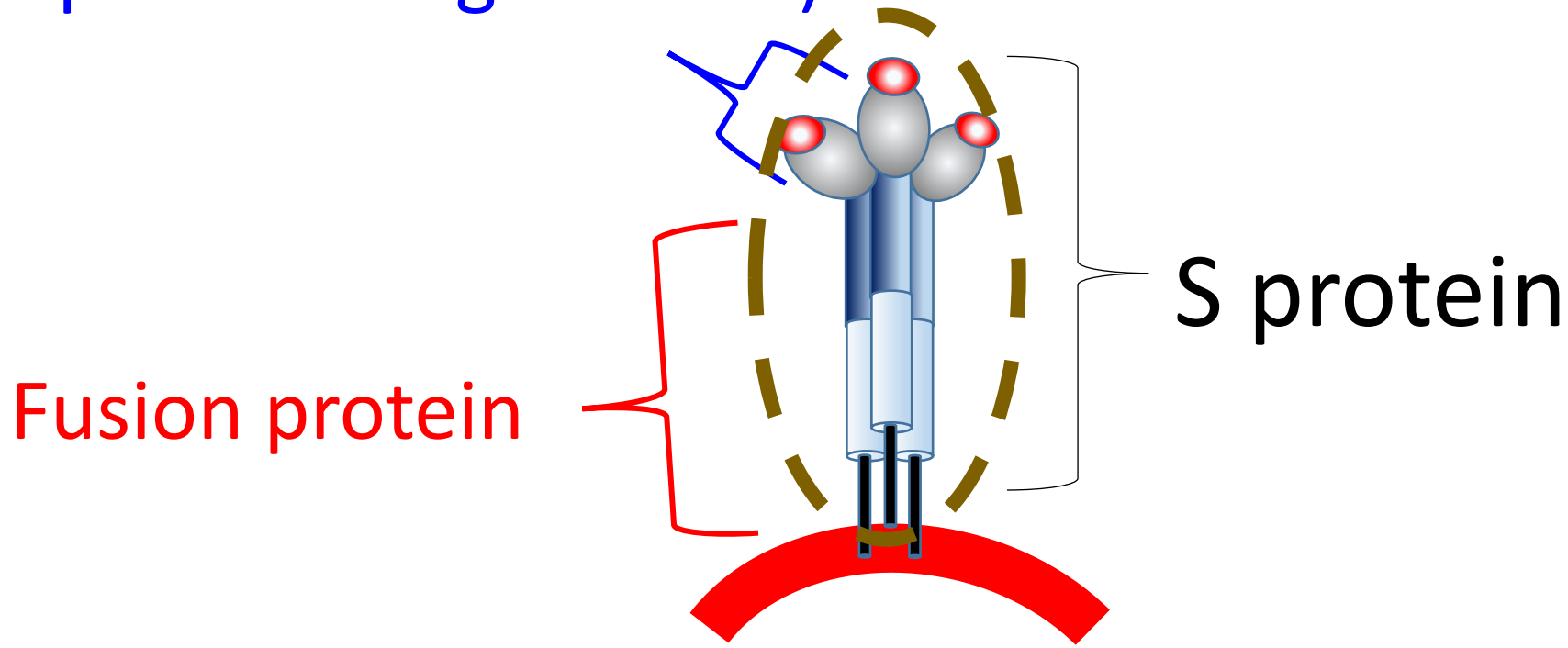
Cell Fusion and Fusion Protein



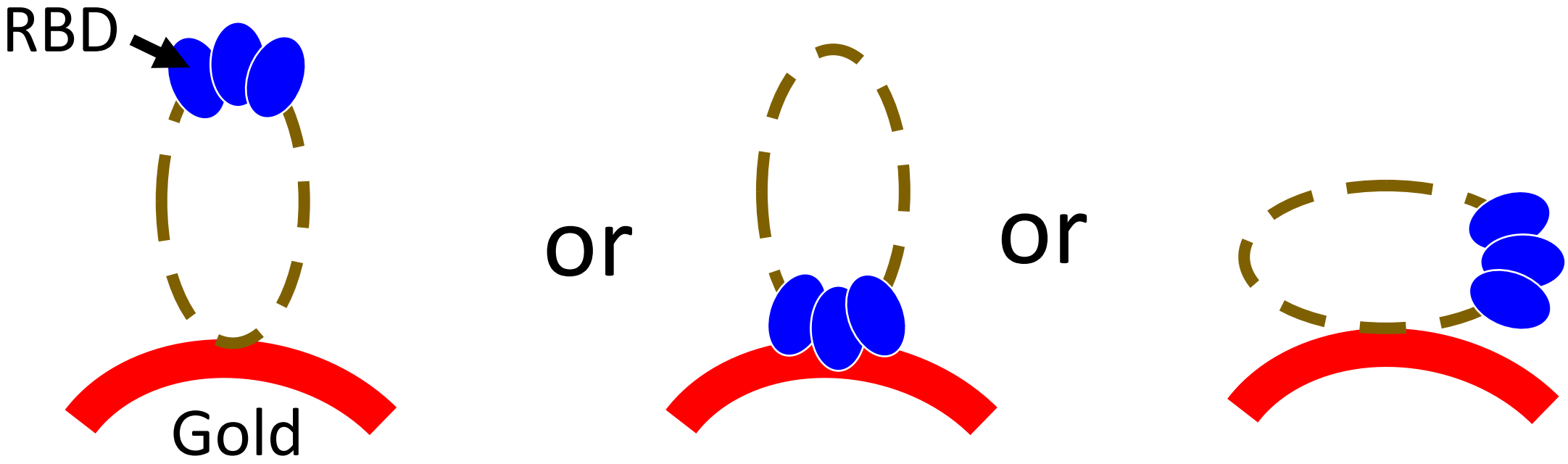
i) RBD portion Down (non-active) conformation becomes Up (active) conformation.
ii) ACE2 attaches to RBD.
iii) S1 sheds out.
iv) S2 attaches on the target cell surface.
v) Hairpin portion of S2 holds back.
vi) Pre-fusion states.
vii) Fusion

We approximate S protein to be roughly two parts:

RBD (Receptor Binding Domain)



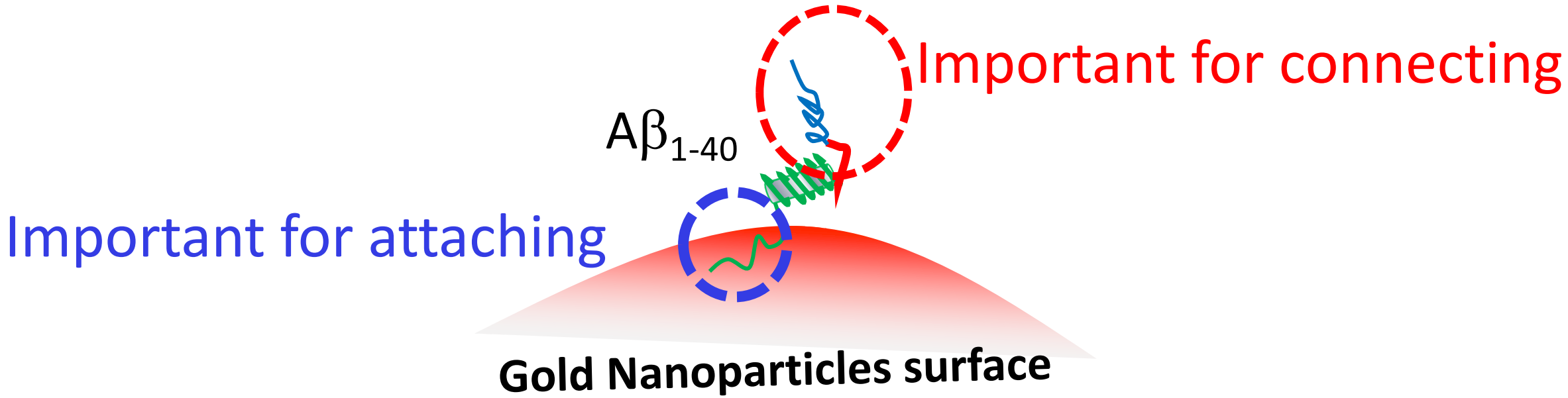
We found S protein adsorbs to the gold, but we do not know if



K. Yokoyama and A. Ichiki, “Spectroscopic Investigation on the Affinity of SARS-CoV-2 Spike Protein to Gold Nano-Particles”, Colloid and Interface Science Communication, Vol. 40, pp.100356-100362 (2021)
https://www.sciencedirect.com/science/article/pii/S2215038220301369

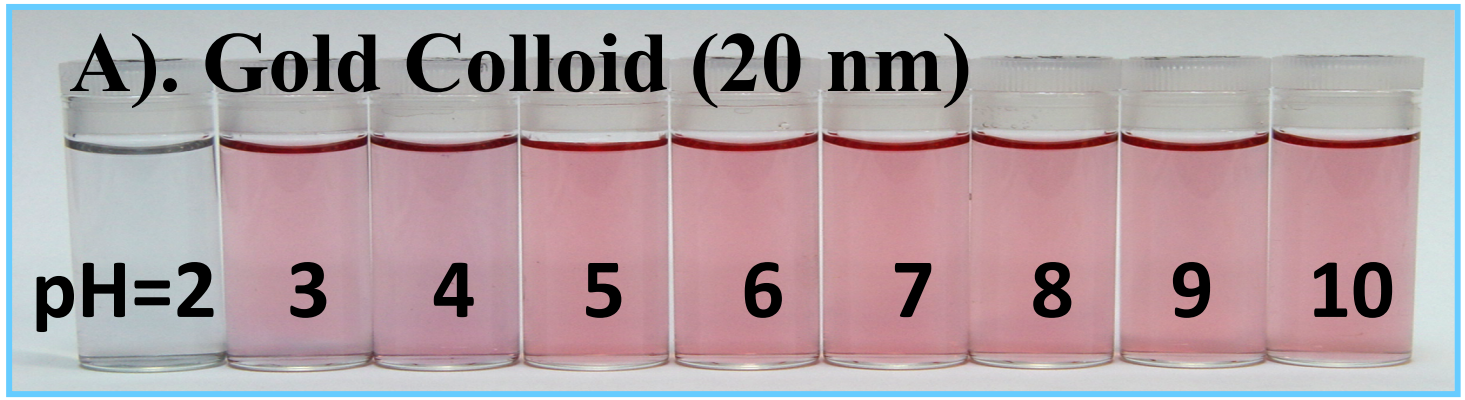
Background:

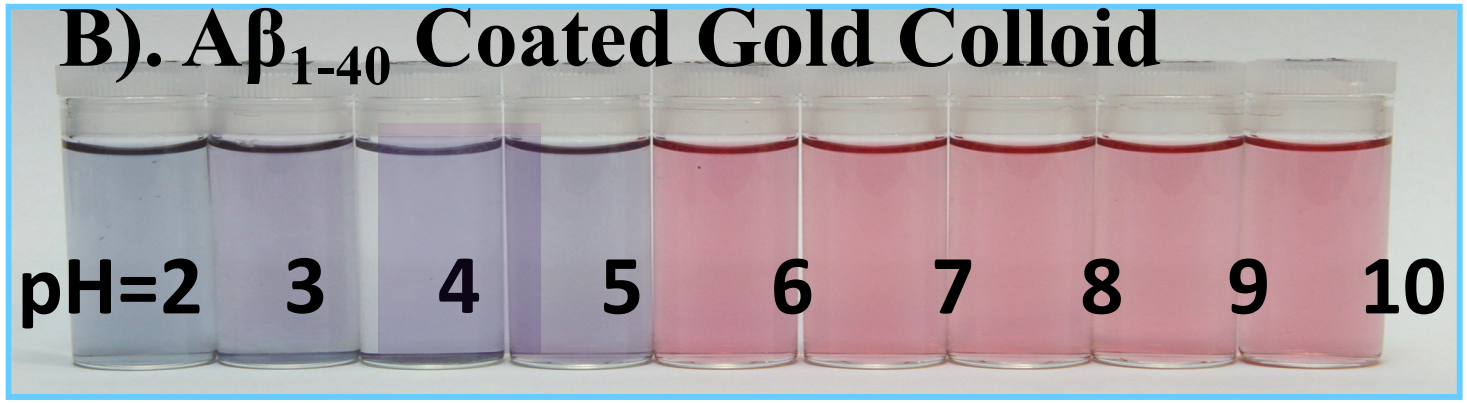
We have been investigating the networking of amyloidogenic peptides, such as ($A\beta_{1\text{-}40}$, α-synuclein, and β2 microglobuin)



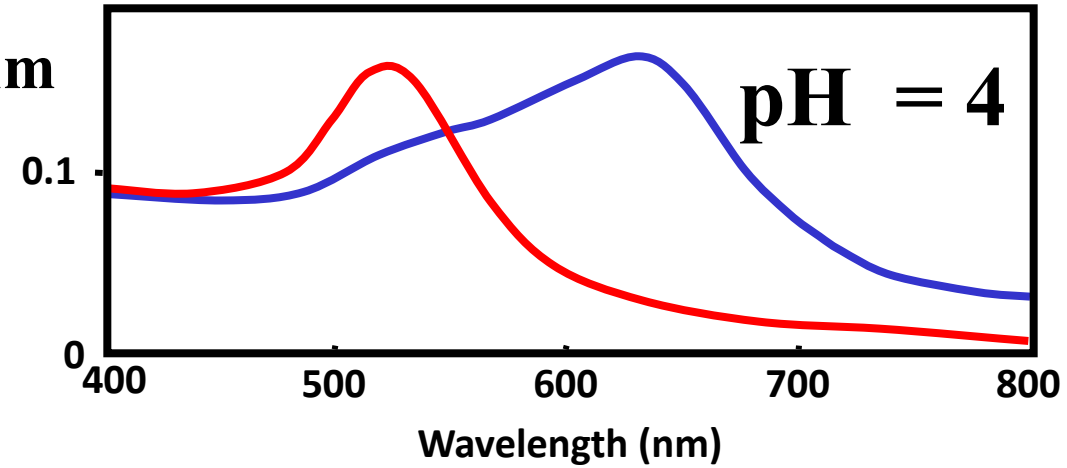
K. Yokoyama et.al.,"Examination of Adsorption Orientation of Amyloidogenic Peptides Over Nano-Gold Colloidal Particle Surfaces" *Int. J. Mol. Sci.* **2019**, *20*(21), 5354; https://doi.org/10.3390/ijms20215354

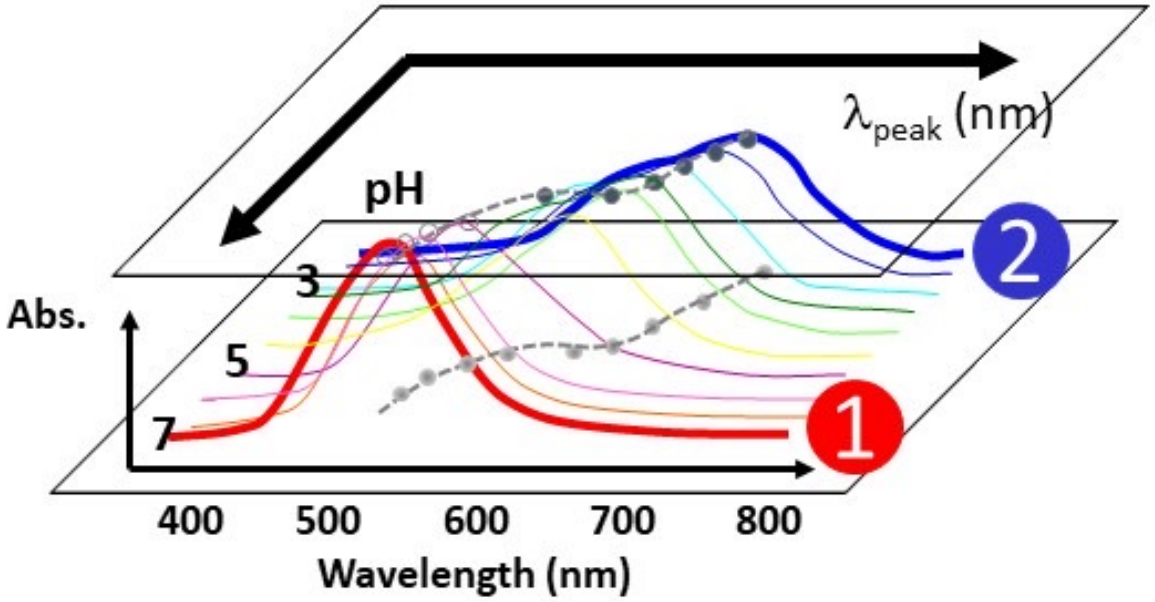
Color of Gold changes depending on pH and protein adsorption



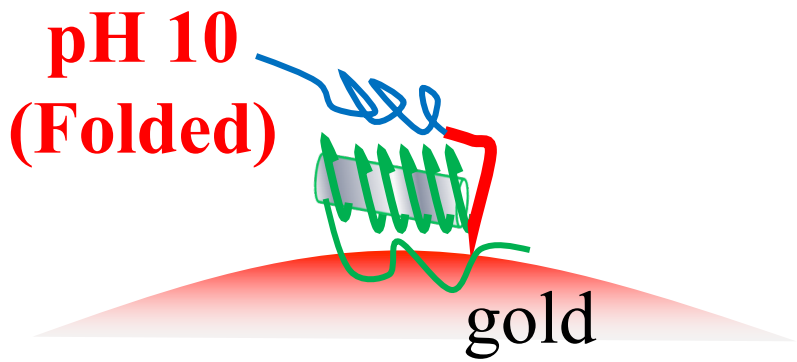


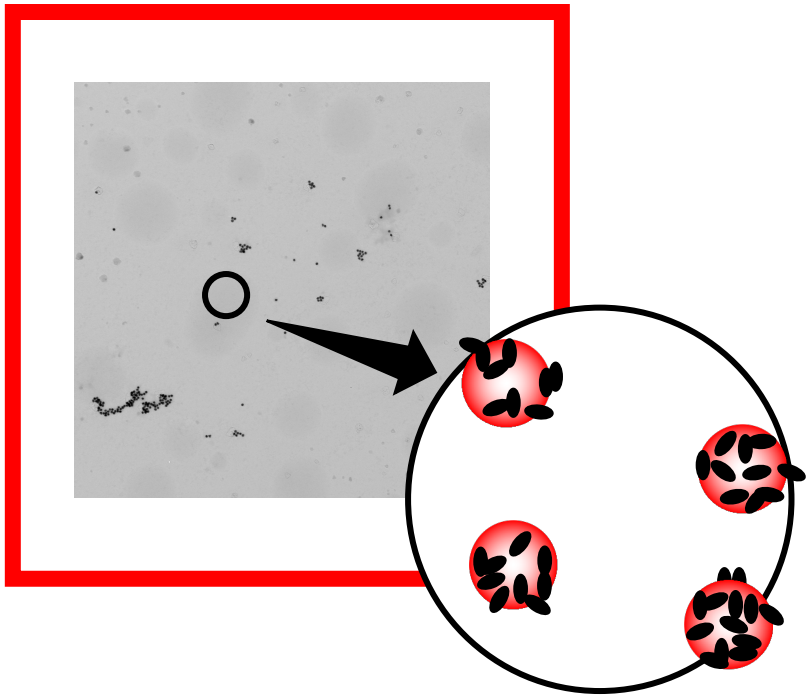
Absorption spectrum



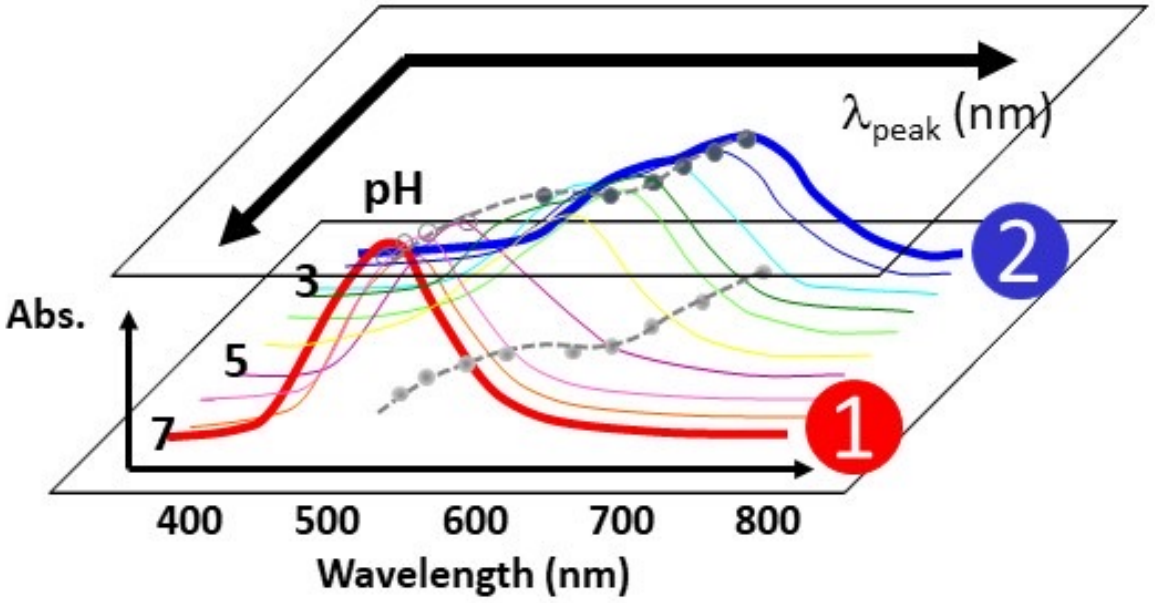


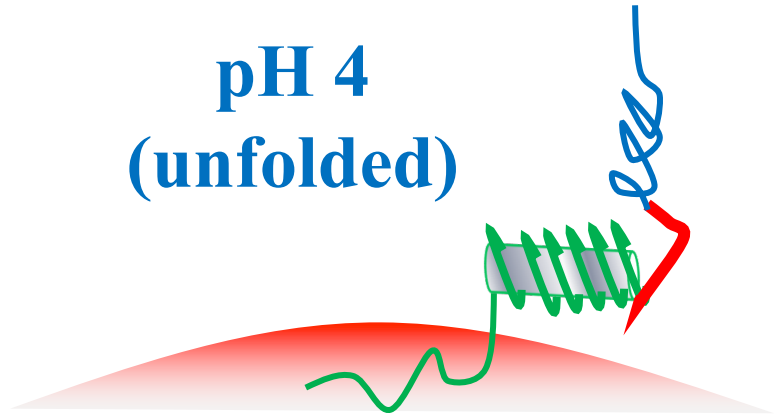
1 Dispersed Gold

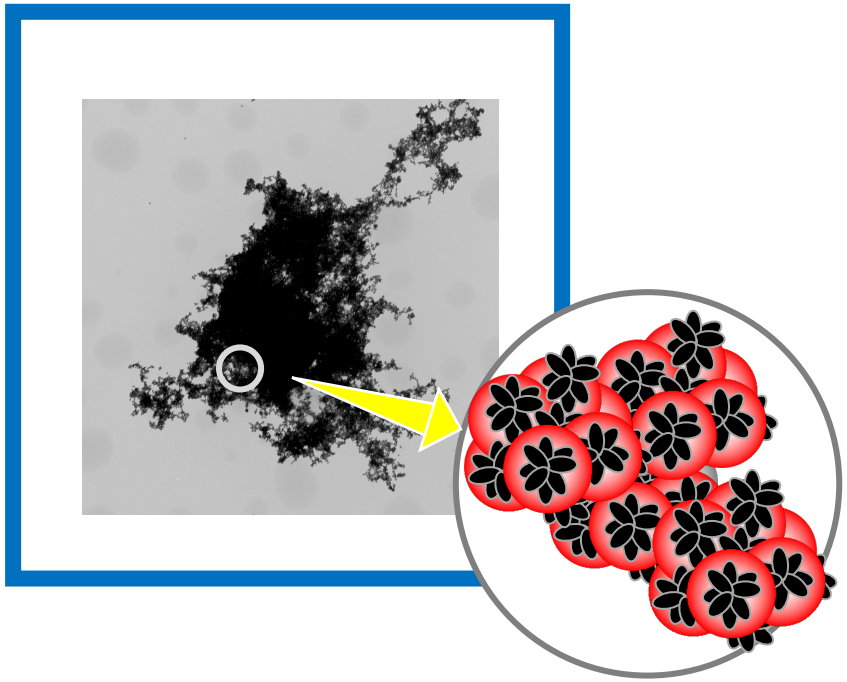


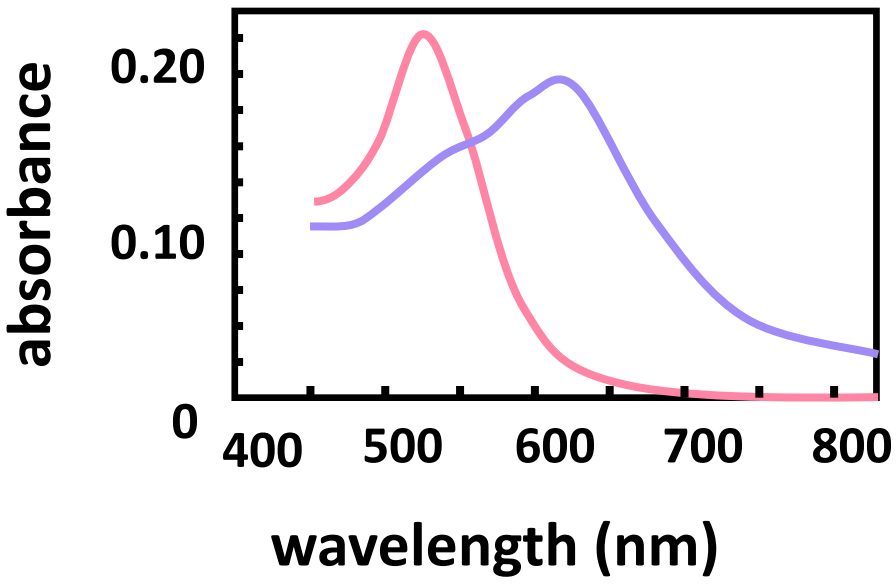


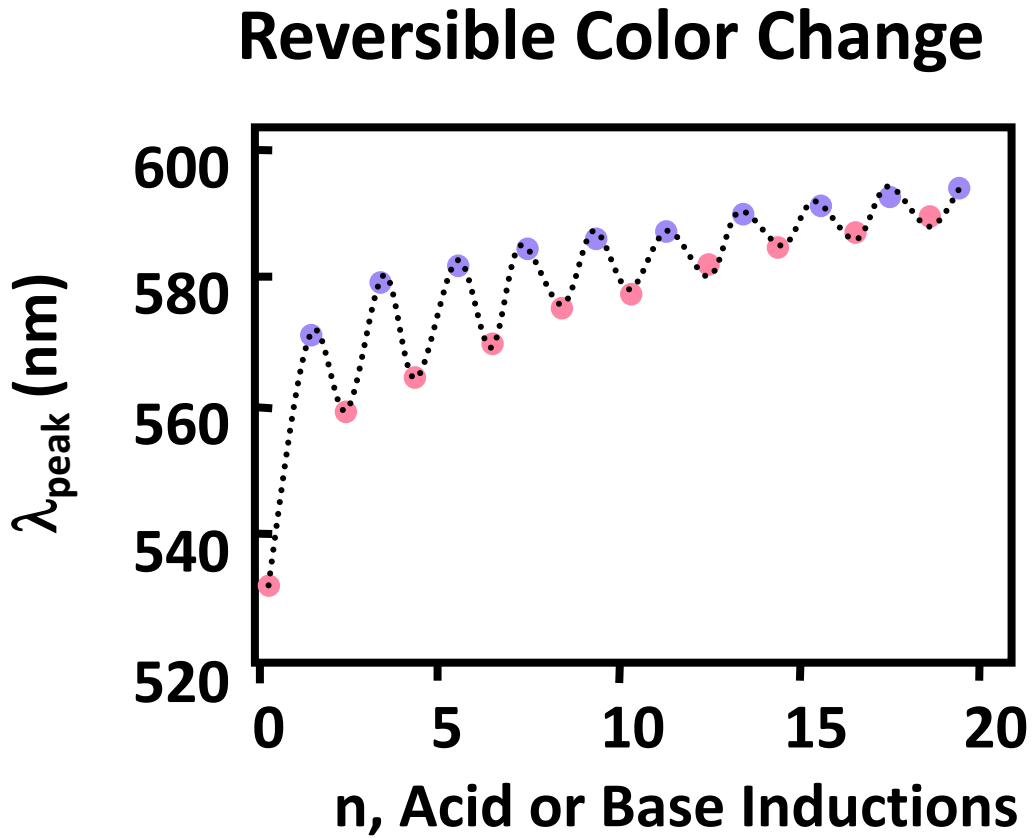
2 Gold Aggregates







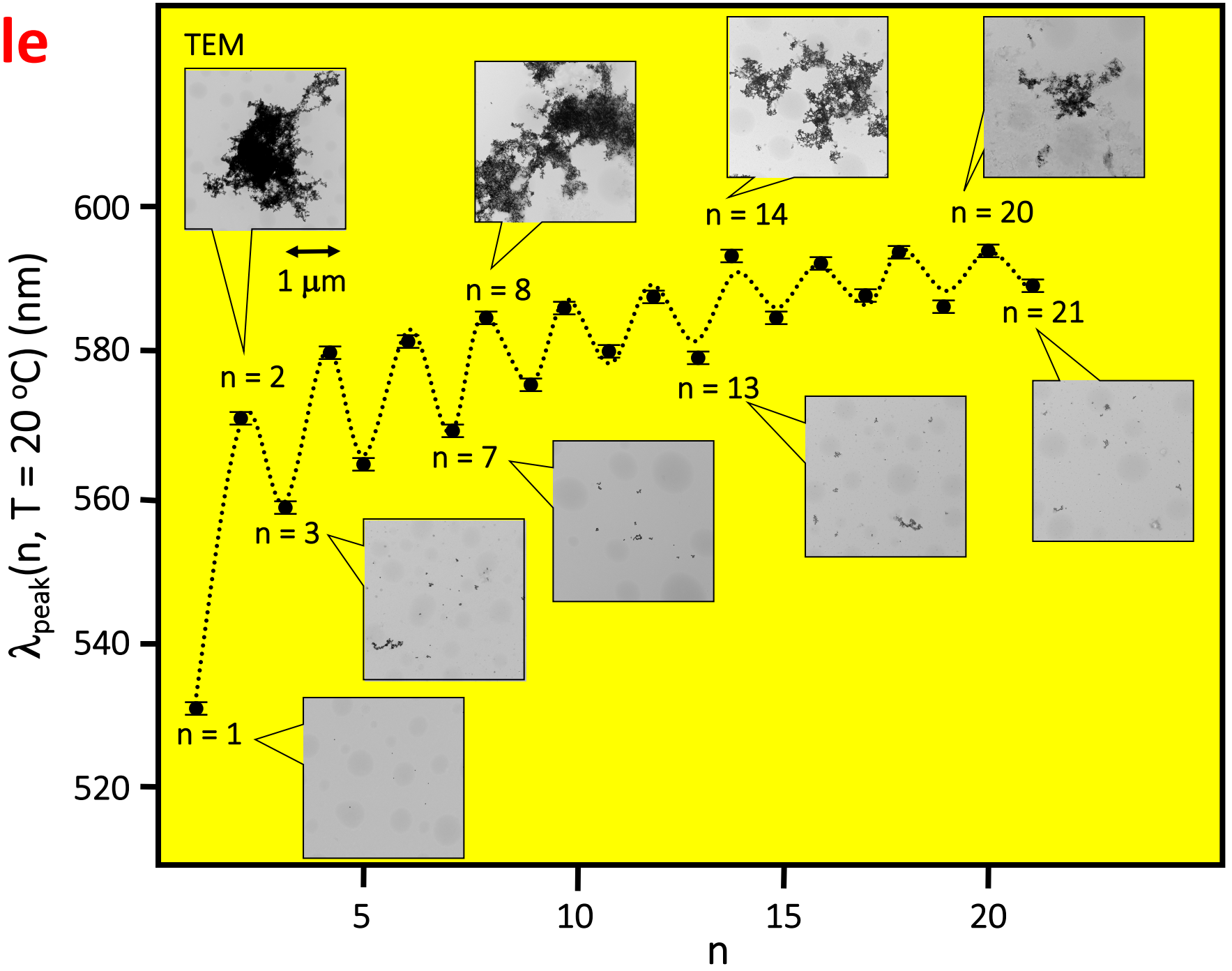




Aβ coated 20 nm gold, pH 10

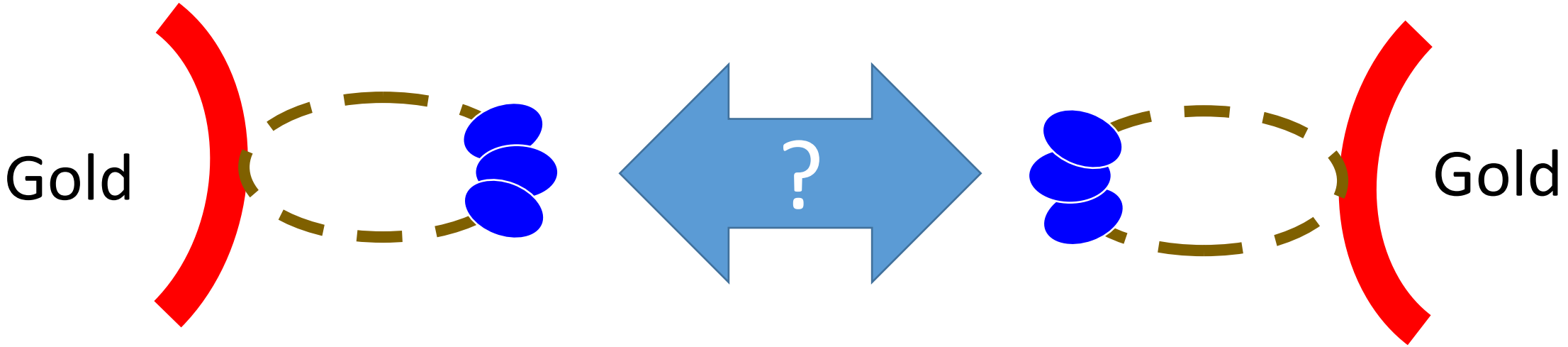
Aβ coated 20 nm gold, pH 4

Quasi-Reversible

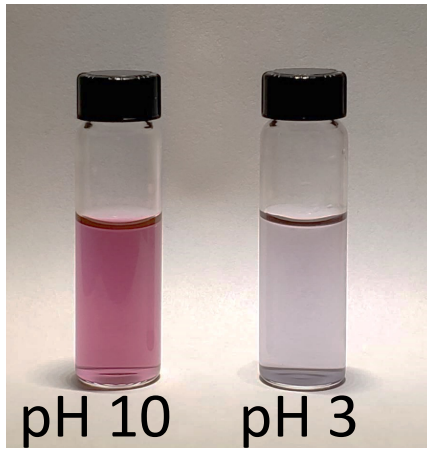


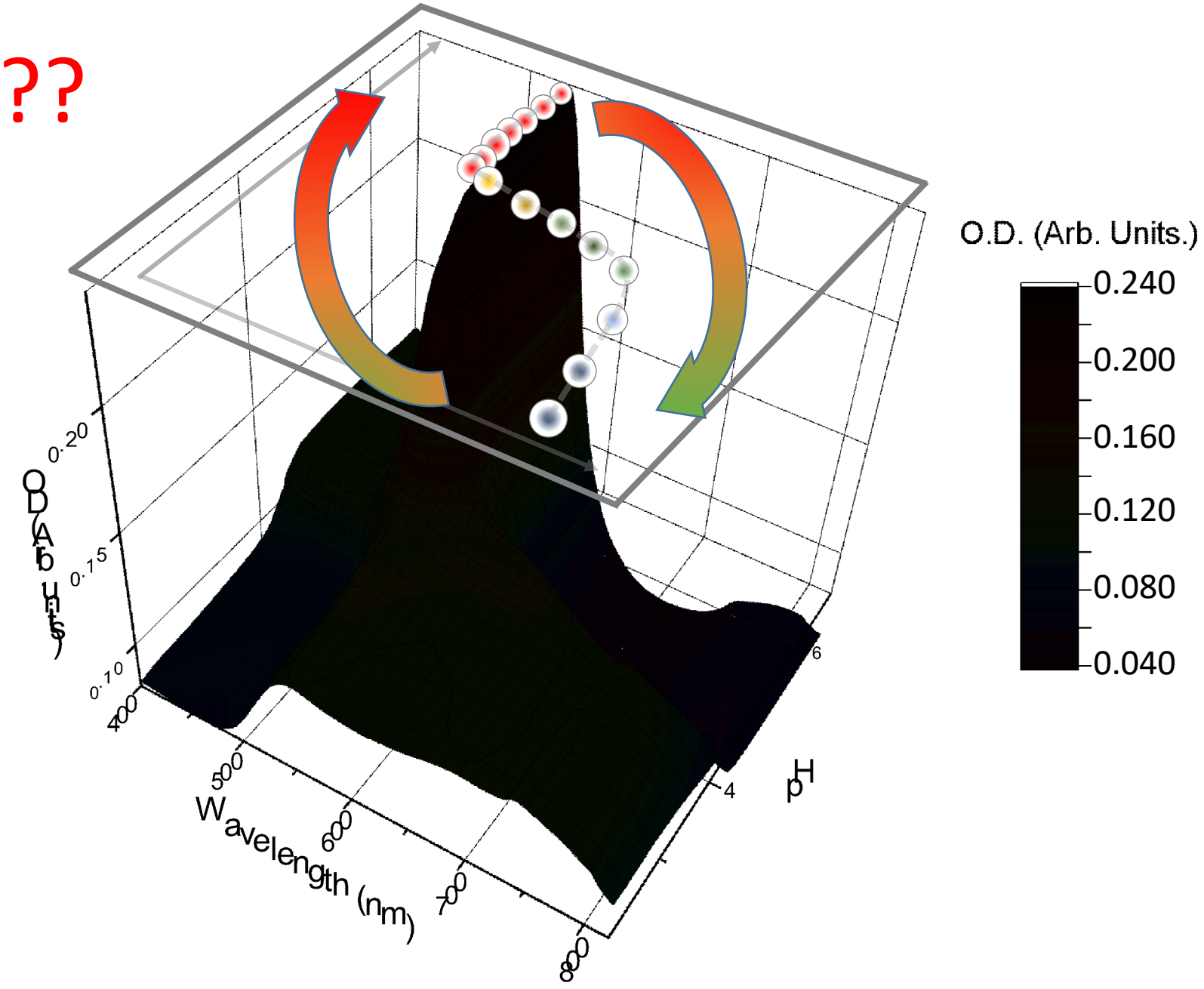
First question:

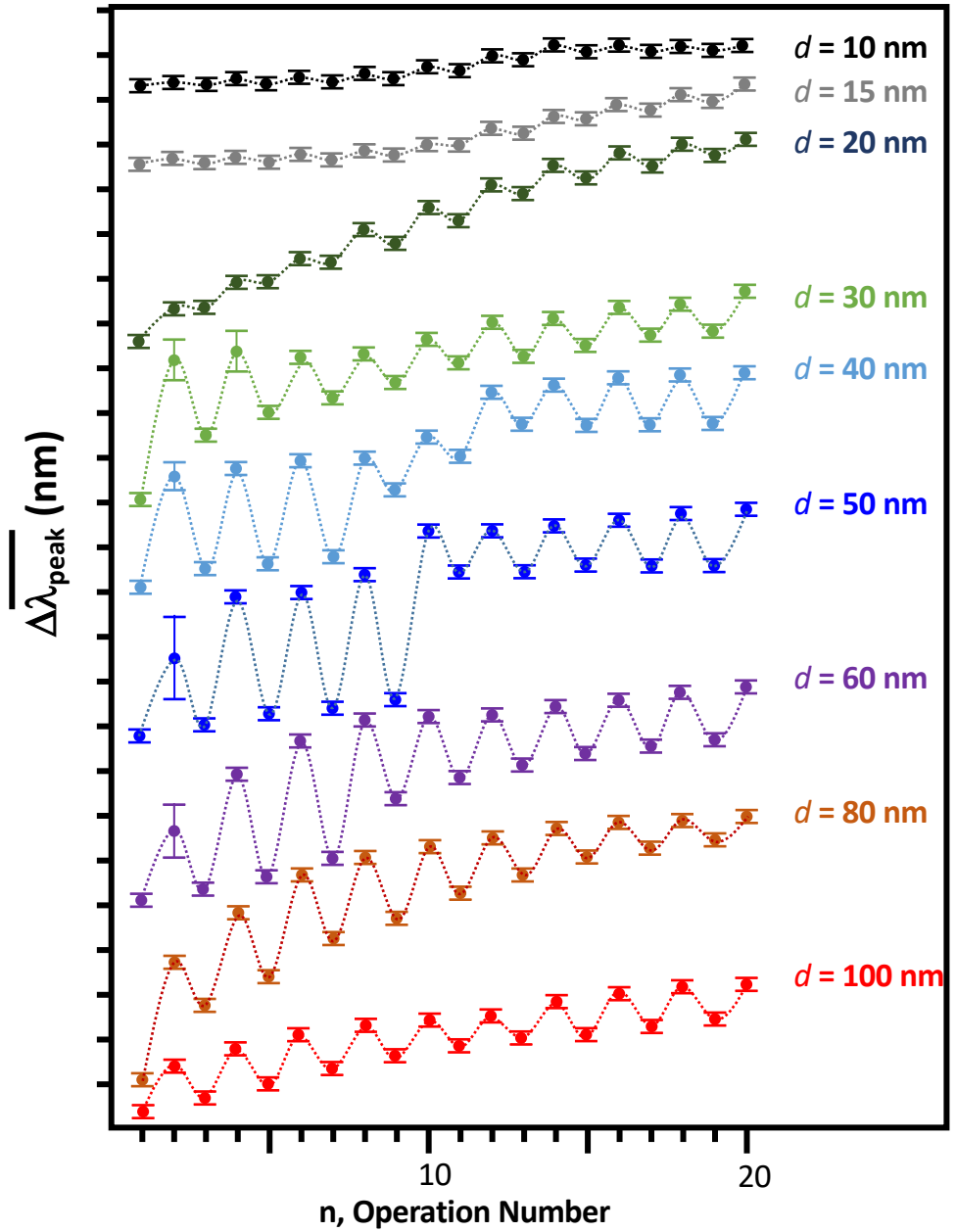
Does S protein acts like a glue to form the aggregates?



Reversible??


pH 10
pH 3

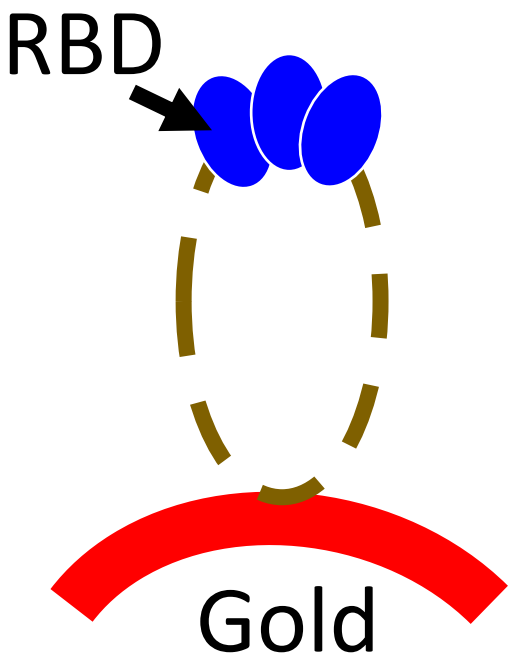

O.D. (Arb. Units.)
0.240
0.200
0.160
0.120
0.080
0.040
0.20
0.15
0.10
400
500
600
700
800
Wavelength (nm)
4
6
pH



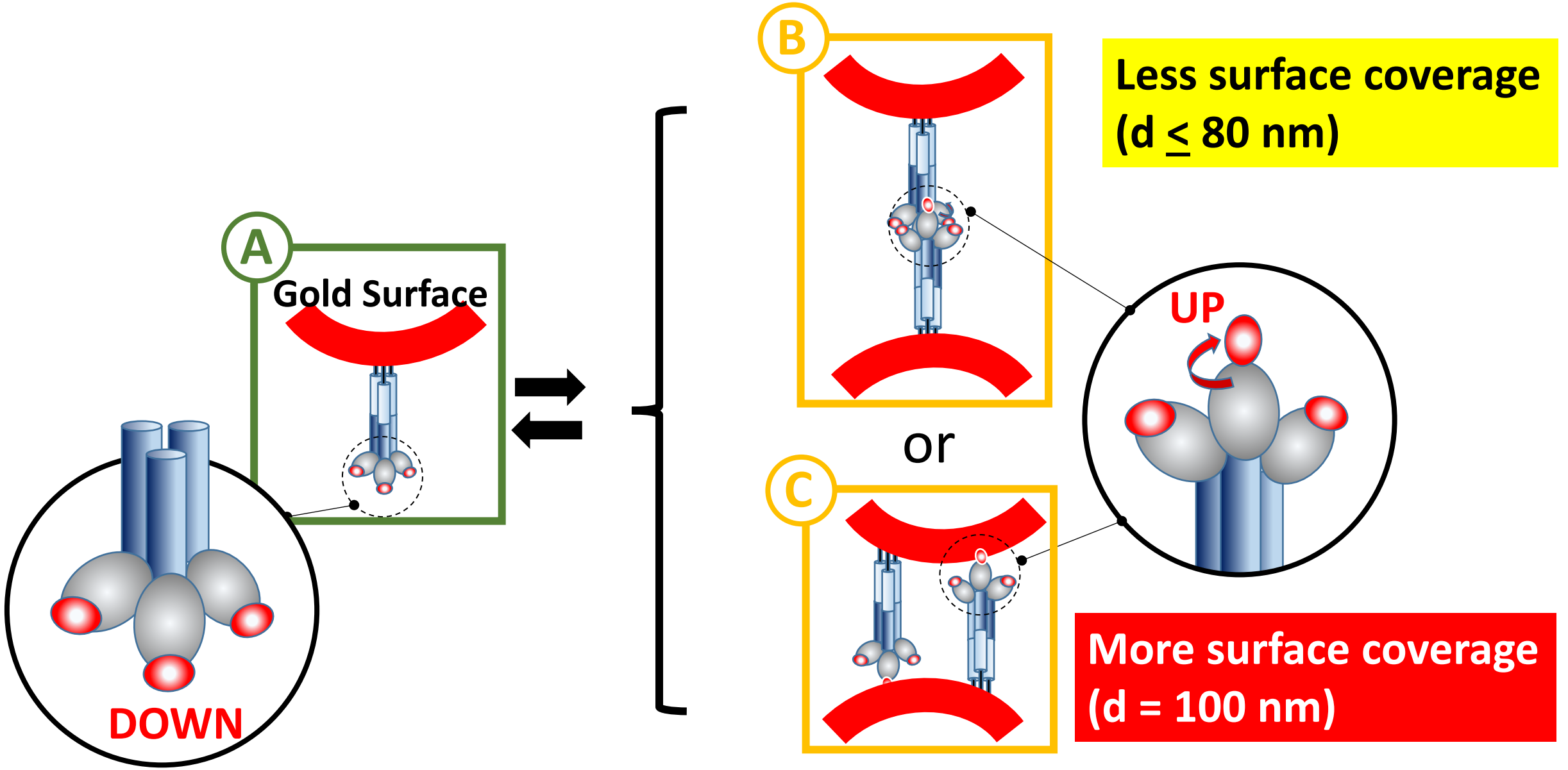
Nano-size dependence: It tends to have more undulation at the larger size.

- **K. Yokoyama** and A. Ichiki, *"Nano-size Dependence in the Adsorption by the SARS-CoV-2 Spike Protein over Gold Nano-Particles*" Colloids and Surfaces A, Volume 615, pp. 126275 – 126281 (2021) *https://www.sciencedirect.com/science/article/pii/S0927775721001448*

The reversible aggregation →
S protein adsorbs on the gold surface.

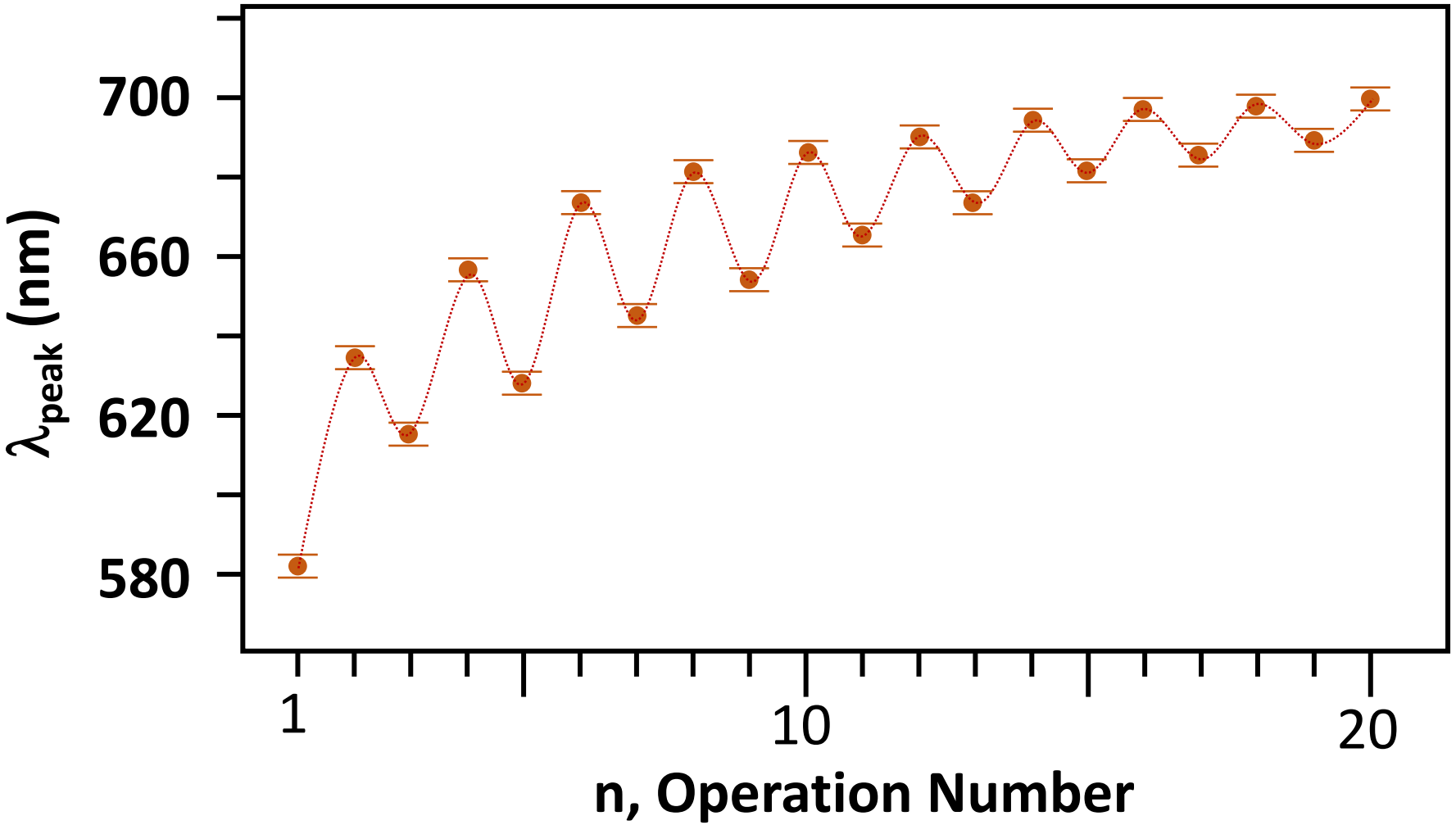


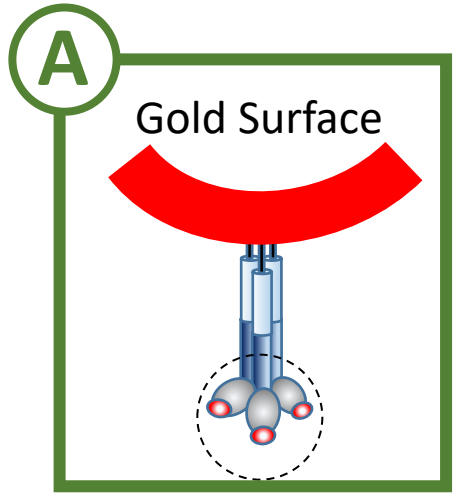
Two possible aggregation processes

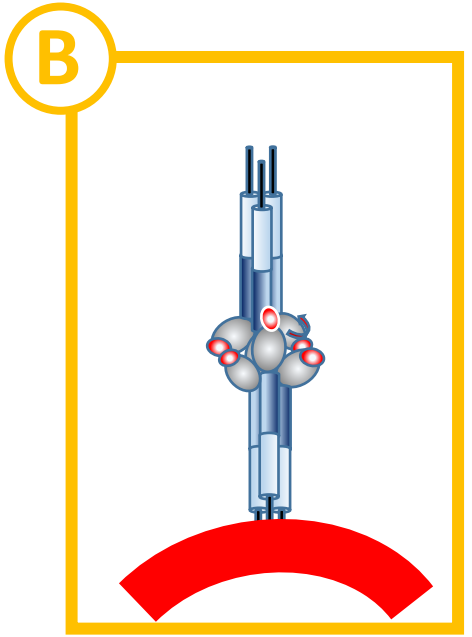


Au 80 nm & S-protein

→ Relatively Low Coverage

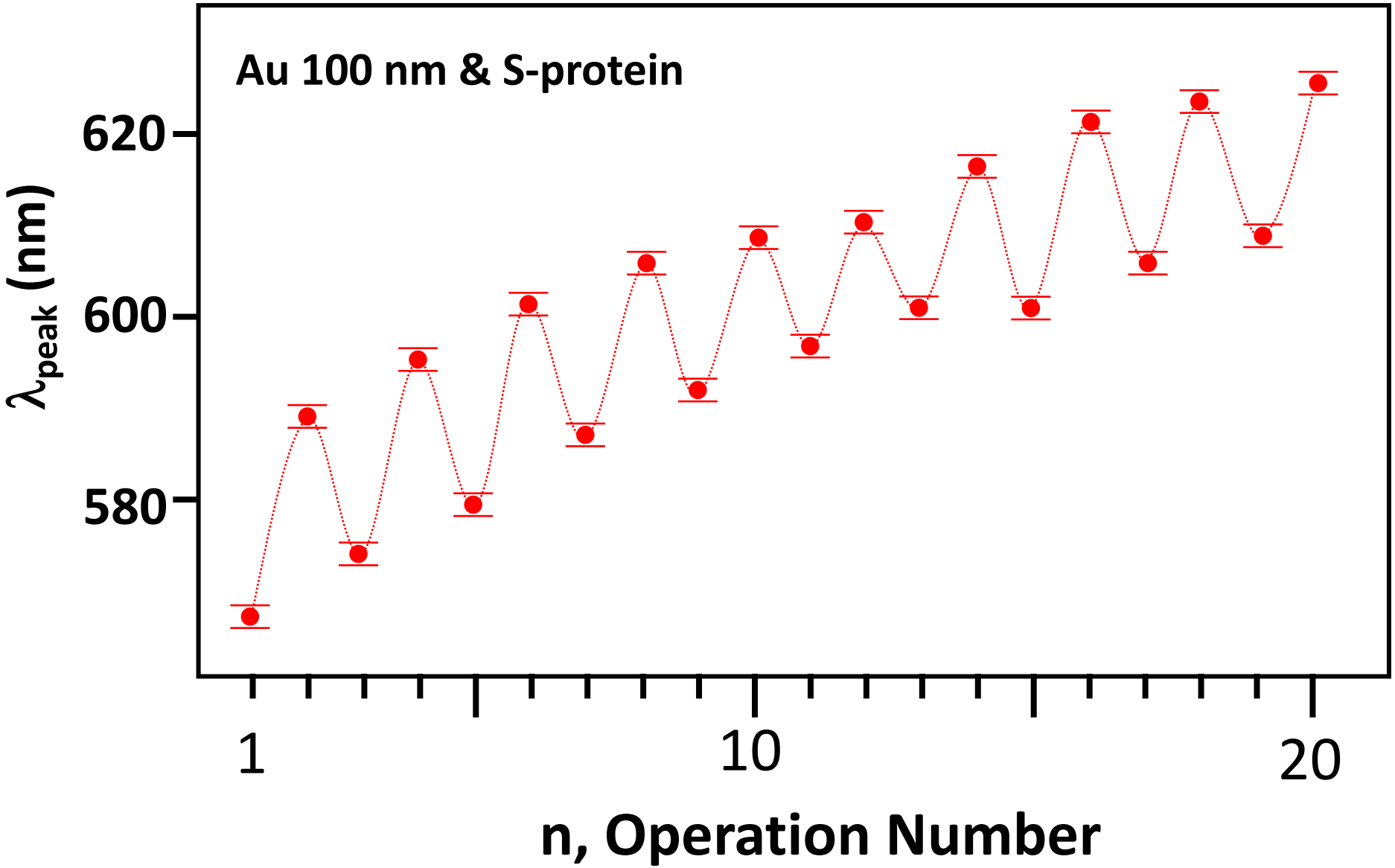


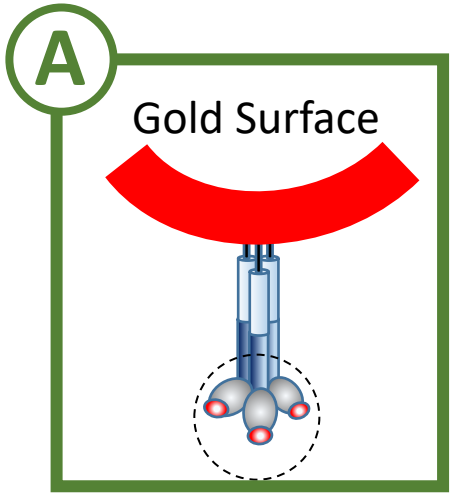


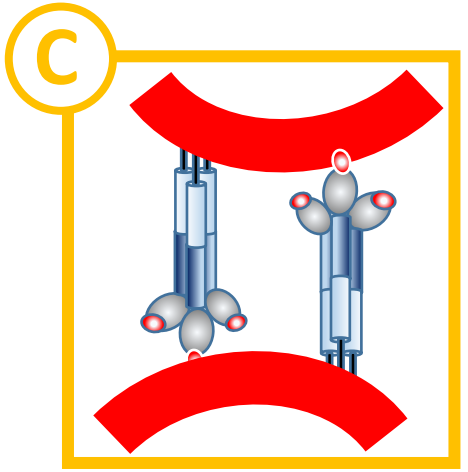


Au 100 nm & S-protein

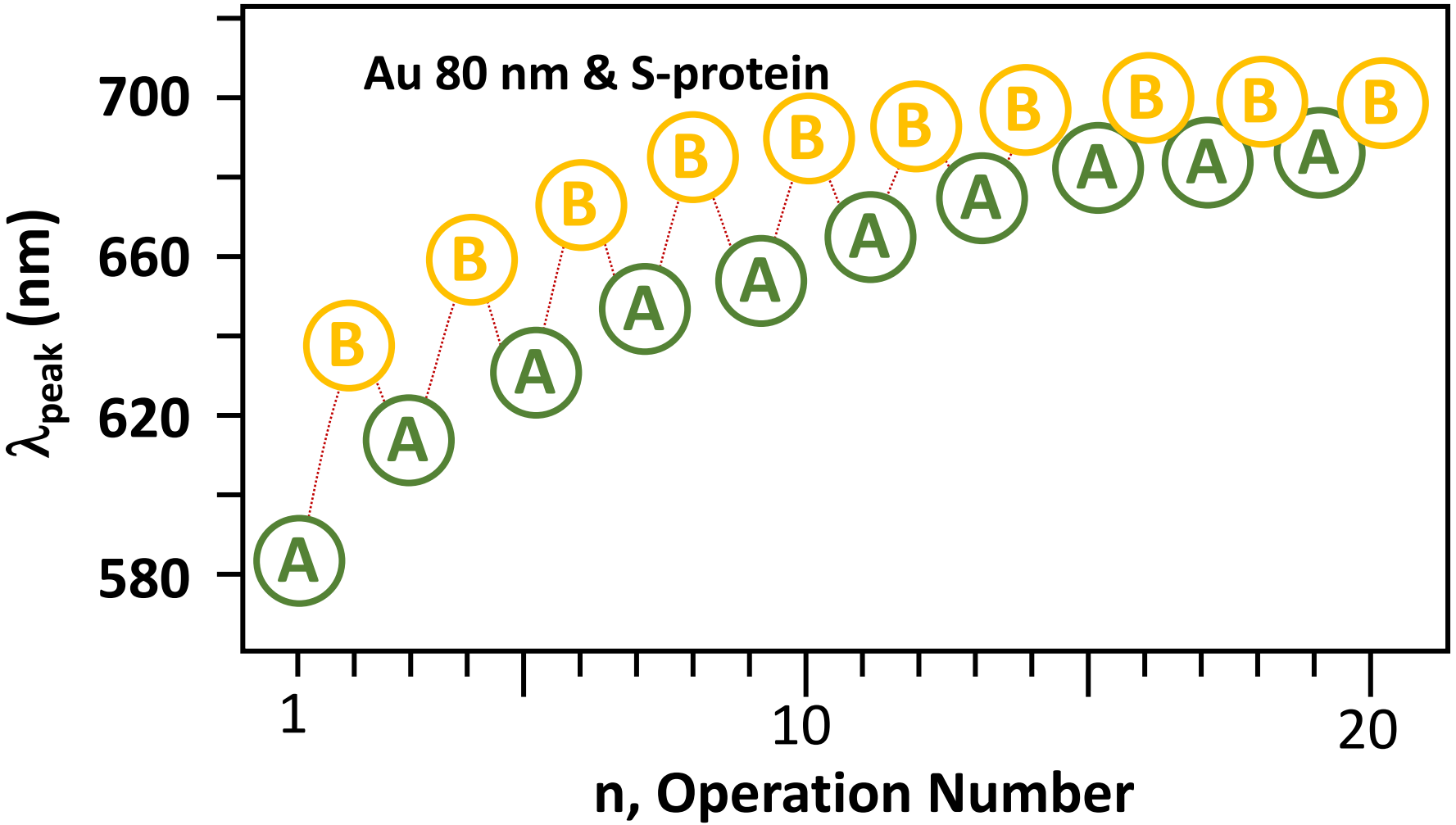
→ Relatively High Coverage

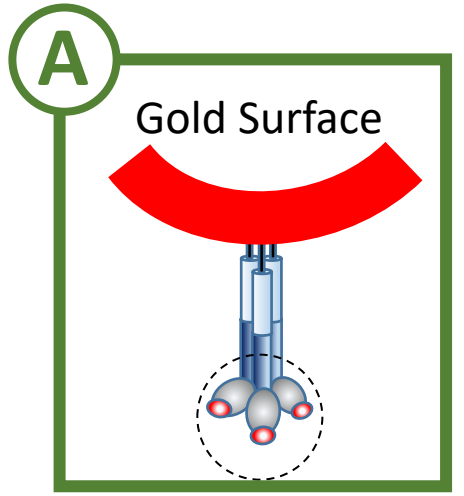


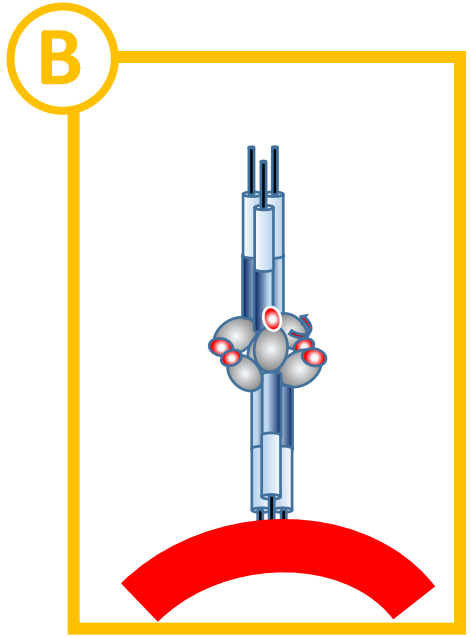




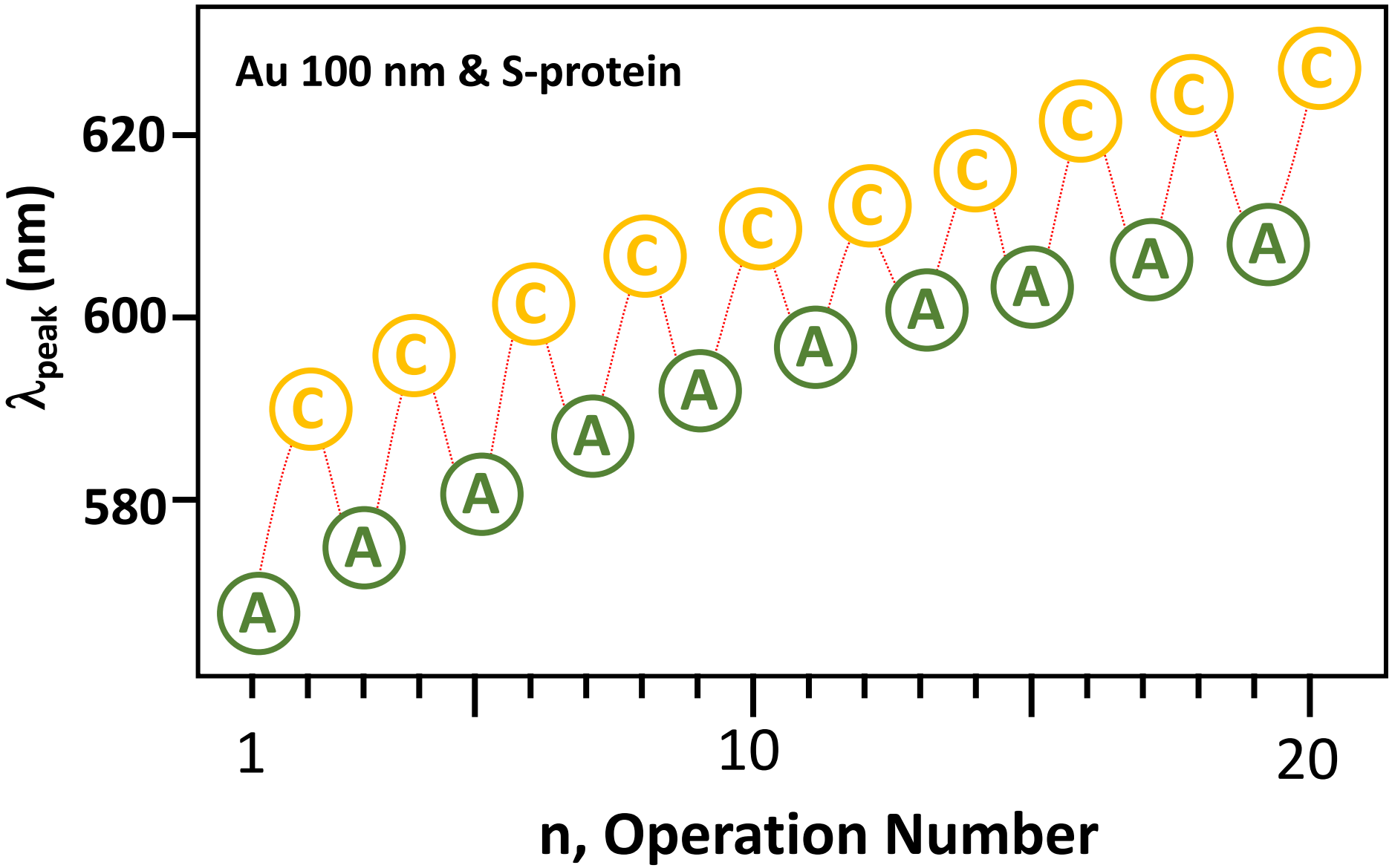
Conclusion 1

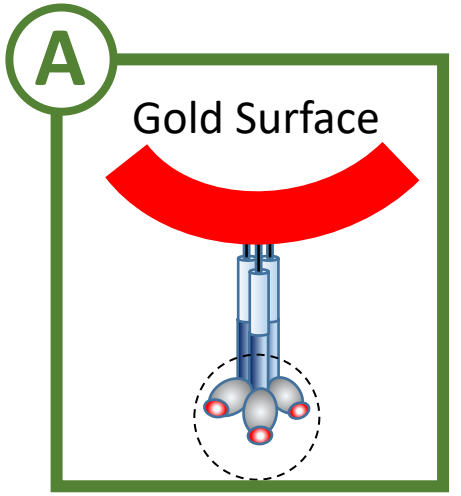


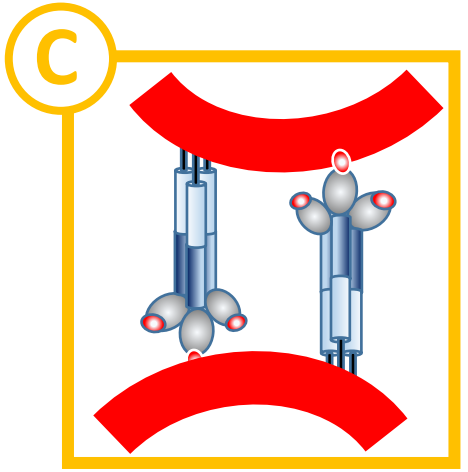




Conclusion 2.







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